THE SCIENTIFIC METHOD

There are many variations of the scientific method, however, I am comfortable with using a five-step progression.

1) Make an observation. This could be an event or problem you have interest in.

2) Develop a hypothesis that can be isolated and tested to solve your problem.

3) Using the hypothesis, develop an experiment, run the experiment and collect data

4) Accept or reject the original hypothesis based on the experimental results. If you reject your original hypothesis, go back and change your hypothesis.

5) Once you are comfortable with the results of the hypothesis, present your results for critical review to your peers

The value of the scientific method is that the statements presented to the public are based on proven data collection and can be readily repeated by others throughout the world. The process helps remove personal prejudices, religious obstruction, or political interference.

Unit Multiplier

Wafi Hassan.

1) What is the prefix for million , 1/1,000,000,000 , 1/ 1000 , a billion, and 1/1,000,000

Mega,

2) What is the letter abbreviation for pico-, mega- , milli-, nano-, deci-

p, M, m, n, d

3) Write the number 5.6 megameters, 10 centimeters, 87 microseconds, 385 nanometers

5.6×10^{6} meters 10×10^{-2} m, 8.7×10^{-5} s, ~~385×10^{-9} m~~ 3.85×10^{-7} m

~~5,600,000 m, 0.~~

4) Use the prefixes to write the numbers 2300 seconds, 10,000,000 bytes, .0036 coulombs

2.3 Kiloseconds, 10 Megabytes, 3.6 millicou

CONVERT THE FOLLOWING:

5) 145 CENTIMETERS PER SECOND TO INCHES PER SECOND

6) 5.08 METERS PER SECOND TO INCHES PER SECOND

7) 128 INCHES PER MINUTE TO FEET PER SECOND

8) 4.63 MILES PER HOUR TO KILOMETERS PER HOUR

9) 125 CUBIC CENTIMETERS TO CUBIC INCHES

5) 145 cm/s

$= \frac{145 \text{ cm}}{1 \text{ second}} \times \frac{1 \text{ inch}}{2.54 \text{ cm}}$

$= \frac{145}{2.54} \text{ in.} = 57.09 \text{ in/s}$

6) 5.08 m/s

$= \frac{5.08 \text{ m}}{1 \text{ sec}} \times \frac{1 \text{ cm}}{0.01 \text{ m}} \times \frac{1 \text{ inch}}{2.54 \text{ cm}}$

$= \frac{5.08 \text{ in.}}{0.01 \times 2.54} = \frac{508}{2.54} \text{ in} = 200 \text{ in/s}$

7) 128 in/min

$= \frac{128 \text{ inch}}{60 \text{ sec}}$

$= \frac{32/15 \text{ inch}}{1 \text{ sec}} \times \frac{1 \text{ ft}}{0.3048 \text{ m}}$

$= \frac{\frac{32}{15} \text{ inch}}{1 \text{ sec}} \times \frac{1 \text{ ft}}{30.48 \text{ cm}}$

$= \frac{\frac{32}{15} \text{ in.}}{1 \text{ sec}} \times \frac{1 \text{ ft}}{12 \text{ in.}}$

$= \frac{32}{15} \times \frac{1}{12} \text{ ft/s} \approx 0.18 \text{ ft/s}$

8) 4.63 mph

$\frac{4.63 \text{ miles}}{1 \text{ hour}} \times \frac{1 \text{ km}}{0.621 \text{ m}}$

$= \frac{4.63 \text{ km/h}}{0.621}$

$= 7.451 \text{ kmph}$

9) 125 cm^3

$125 \text{ cm}^3 \times \left(\frac{1 \text{ inch}}{2.54 \text{ cm}}\right)^3$

$= 125 \text{ cm}^3 \times \frac{1 \text{ in}^3}{16.387064 \text{ cm}^3}$

$= \frac{125}{16.387064} \text{ in}^3$

$= 7.628 \text{ in}^3$

Wafi Hassan.

HOMEWORK

SOLVE FOR v

a) $d = v\,t$

$v = \frac{d}{t}$

b) $t = d / v$

$v = \frac{d}{t}$

c) $a = v^2 / 2d$

$v = 2ad$

d) $v / a = b / c$

$v = \frac{ab}{c}$

SOLVE FOR E

a) $F = E / S$

$E = FS$

b) $m = 2E / V^2$

$2E = mV^2$

$\therefore E = \frac{mV^2}{2}$

c) $E / C^2 = m$

$E = mc^2$

SOLVE FOR d

A) $v_f^2 = v_o^2 + 2ad$

$2ad = V_f^2 - V_o^2 \Rightarrow \boxed{d = \frac{V_f^2 - V_o^2}{2a}}$

SOLVE FOR v_o^2

a) $v_f^2 = v_o^2 + 2ad$

$v_o^2 = V_f^2 - 2ad \Rightarrow 2ad = V_f^2 - V_o^2$

$\therefore \boxed{d = \frac{(V_f^2 - V_o^2)}{2a}}$

SOLVE FOR a

$v_f = v_o + at$

$a = \frac{V_f - V_o}{t}$

$v = 2as$

$a = \frac{V}{2s}$

b) $y = v_o t + 1/2\, a t^2$

$a \frac{at^2}{2} = y - v_o t$

$\Rightarrow a = \frac{2y - 2v_o t}{t^2} = \boxed{\frac{2y - 2v_o t}{t^2}}$

SOLVE FOR l $\quad T = 2\pi\sqrt{\frac{l}{g}}$

$\frac{l}{g} = \frac{T^2}{4\pi^2} \Rightarrow \boxed{l = \frac{T^2 g}{4\pi^2}}$

Solve for B $\quad \frac{1}{B} + \frac{1}{120} = \frac{1}{14.12}$

$\frac{1}{B} = \frac{1}{14.12} - \frac{1}{120}$

$\Rightarrow B = \left(\frac{1}{\frac{1}{14.12} - \frac{1}{120}}\right)$

Wafi Hassan
P1

Metric and Conversion

1) Express the following numbers in scientific notation.

a) 5800 m b) .004 m c) 302,000,000 m d) 86,000,000,000 m e) .000023 m

a) 5.8×10^3 m b) 4×10^{-3} m c) 3.02×10^8 m d) 8.6×10^{10} m e) 2.3×10^{-5} m

2) Convert the following units into equivalent meter units

a) 1.1 cm b) 6.7 mm c) 3000 dm

a) 1.1×10^{-2} m b) 6.7×10^{-3} m. c) 300 m

Solve the following problems

a) $5.0 \times 10^6 + 3.0 \times 10^6 = 8 \times 10^6$

b) $4.0 \times 10^{-4} \times 3.0 \times 10^{-4} \Rightarrow 12 \times 10^{-8} = 1.2 \times 10^{-7}$

c) $2.0 \times 10^2 \times 4.0 \times 10^3 = 8 \times 10^5$

d) $6.3 \times 10^{-8} \times 5.5 \times 10^{-9} \Rightarrow 6.3 \times 5.5 \times 10^{-17} = 34.65 \times$
$= 3.465 \times 1$

e) $6.0 \times 10^{-4} / 1.5 \times 10^{-3} \Rightarrow \frac{6.0}{1.5 \times 10^{-3+4}} = \frac{6}{15}$

f) $1.2 \times 10^{-3} \times 2.0 \times 10^{-2} \Rightarrow 2.4 \times 10^{-5}$

g) $8.1 \times 10^6 - 3.3 \times 10^5 = (81 - 3.3) \times 10^5$
$\Rightarrow 77.5 \times 10^5 = 7.75 \times 10^5$

h) $6.0 \times 10^{-5} - 2.0 \times 10^{-5} \Rightarrow (6-2) \times 10^{-5} = 4 \times 10^{-5}$

3) The radius of the earth is 6.37×10^3 km. Convert the kilometers into meters.

6.37×10^6 m.

4) Give the following written prefixes for the following abbreviations.

a) km b) p c) dm d) m e) ml f) cm

Kilo- pico- deci- m milli- centi-

5) The word MKS refers to Meters-Kilograms-seconds / metric system

6) The total number of SI units are 7. a) 2 b) 3 c) 5 d) 7

7) The proper SI unit for: Length is meters. Mass is kilogram
Light is Candela, temperature is degree Celsius (°C), electric current is Ampere, amount of a substance is mole.

8) Define physics Study of the physical world & energy

9) The escape velocity of the Earth is @ 11 km/s. What is its velocity if it was in miles per hour?

6.835×3600
$= 24606.30$ m
$= 2.460 \times 10^4$ m

10) The car moves 40 m in 10 secs. What is its velocity in m/s? 4 m/s, and in ft/s?

↓
13.12 ft/s

Wafi Hassan

Metric Review Worksheet

1) The correct form written in scientific exponent form for this number .00592 m is
a) 5.92 mm b) 592×10^5 m c) 5.92×10^3 (d) 5.92×10^{-3} m

2) The most important step in the scientific method is peer review.

3) Show the correct exponent associated with the metric abbreviation.

giga- 10^9 deci- 10^{-1}

milli- 10^{-3} nano- 10^{-9}

pico- 10^{-12} micro- 10^{-6}

centi- 10^{-2} kilo- 10^3

mega- 10^6

4) What is the SI unit for a) length b) time c) mass d) luminous
m s kg cd
e) temperature f) area g) density h) electric current i) amount of a substance
K m^2 kg/m^3 Amps mole.

5) How many SI units are there? 7

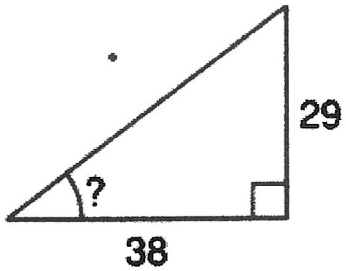
6) How do they attempt to relate each standard of measurement when they define each unit?
They relate to a ~~physical measurable unit~~ fundamental natural constants

7) What is a "mks" system and if you caught one would it hurt you? Meters kilograms seconds

8) Is a "fps" like a "mks"? What is it? No. Foot pound second

9) Convert 25 miles per hour into miles per second? Then convert it into meters per second?
6.94×10^{-3} miles/s. | 11.176 m/s.

10) How many yards are in a football field (add the end zone yardage)? How many feet are in that field? How many meters are in that field?



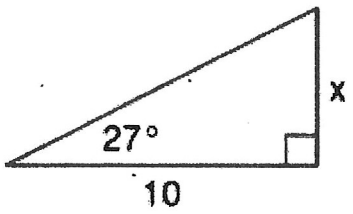
· 40 yards
· 120 ft.
· 36.576 m

11) Solve for the unknown angle.

$\tan(\theta) = \frac{29}{38}$

$\Rightarrow \theta = \tan^{-1}\left(\frac{29}{38}\right) = 37.35^\circ$

Metric Review Worksheet



$10 \tan(27^\circ) = x$

$\therefore x = 5.095$

12) Solve for the unknown side.

13) The international language for business is English. The language for physics is mathematics

14) Solve for x: $c + d = x/6$

$\therefore x = 6c + 6d$

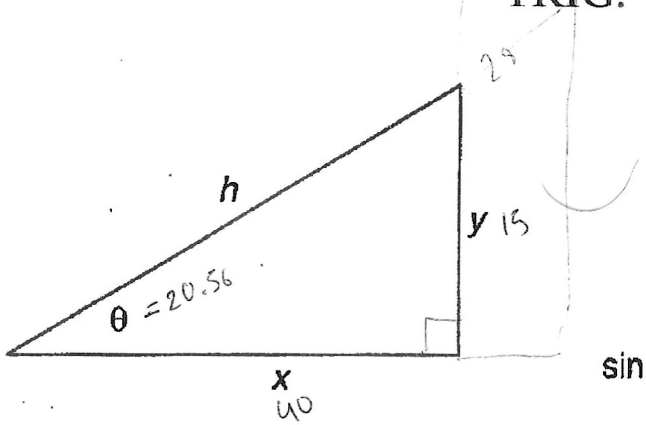
15) Write the following numbers using the metric prefix.

a) .000046 m 46 μm b) 32 000 m 32 Km c) .0095 m 9.5 mm d) .0000000081 m 8.1 nm

16) The reason we use the scientific method is to be free from biases.

TRIG. Worksheet 1

Name Wafi Hassan

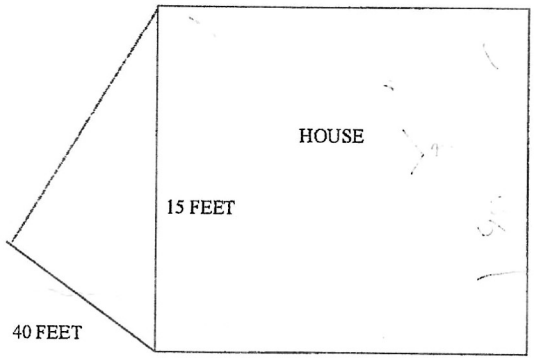


$$\sin\theta = \frac{y}{h} \quad \cos\theta = \frac{x}{h} \quad \tan\theta = \frac{y}{x} = \frac{15}{40}$$

$$\theta = \tan^{-1}\left(\frac{15}{40}\right) \approx 20$$

1) A house is 15 feet tall and its shadow is 40 feet long (from the base of the house to the end of its shadow). What is the angle of the shadow with the ground? If its neighbor's house was 28 feet tall how long would the shadow be? $\tan(20.56) = \frac{28}{x}$

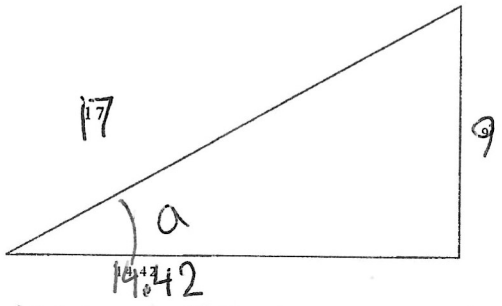
$$\therefore x = \frac{28}{\tan(20.56)} = 74.67 f$$



2) A baseball diamond has one side of 90 feet (thus each side is equal to 90 feet). What is the distance from home to second base? From first base to the pitcher's mound?

$\sqrt{90^2+90^2} = \sqrt{16200} \approx 127.28 ft$ // $\frac{90}{\sqrt{2}} = \frac{90\sqrt{2}}{2} = 45\sqrt{2}$ ~~56.57 ft~~ ? $= 63.64 ft$

3) Using the triangle given find sin, cosine, and its tangent of angle a.



$$\sin(a) = \frac{9}{17}$$

$$\cos(a) = \frac{14.42}{17} = \frac{721}{85}$$

$$\tan(a) = \frac{9}{14.42} = \frac{450}{721}$$

4) Find the two angles of a right triangle if the hypotenuse is 15 with one side equal to 12. (hint: Pythagorean's Theory and trig functions)

$$\theta_1 = \sin^{-1}\left(\frac{12}{15}\right) = 53.13^\circ$$

15 12

$$\theta_2 = 90^\circ - 53.13^\circ = 36.87^\circ$$

Wafi Hassan P1.

Trig. IV

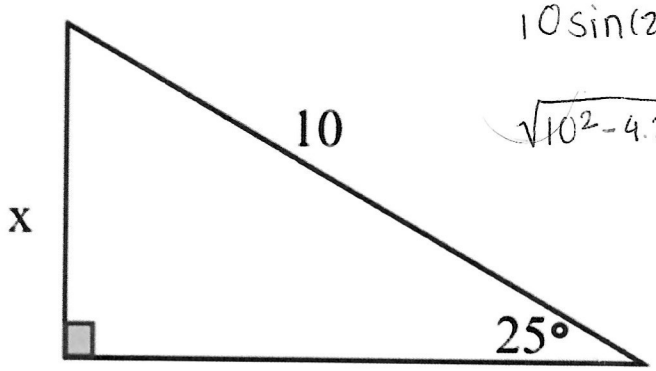


Figure 1

$10\sin(25)$ 1) Please solve for X found in Figure 1 using your trig functions. 4.226

$\sqrt{10^2-4.23^2}$ 2) Using Pythagorean theorem please find the length of the unknown side in Figure 1. 9.063

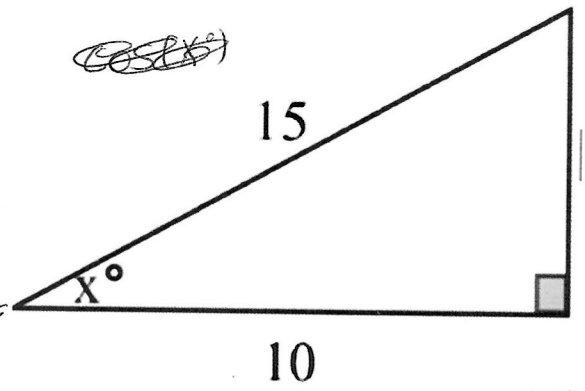
3) Find the remaining angle in Figure 1 using the inverse function of sine.

$\sin^{-1}\left(\frac{9.063}{10}\right) \approx$ 65.0°

$\cos^{-1}\left(\frac{10}{15}\right)$ 4) Using the inverse function of cosine, solve angle X in figure 2. 48.19°

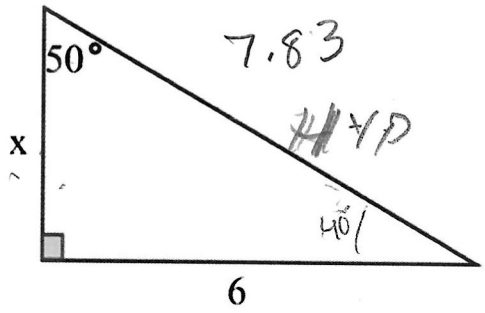
5) Solve for the unknown side using the Pythagorean theorem in Figure 2.

$\sqrt{15^2-10^2} = 5\sqrt{5}$



$\sin 50° = \frac{6}{17}$

Figure 2



7.83

HYP

40

Figure 3

6) Using sin, solve for the ~~hypothesis~~ of the triangle in Figure 3. 7.83

$\frac{6}{\sin(50}$

7) Solve for side X in Figure 3 using the ~~inverse~~ of tangent.

~~$\tan 50 = \frac{6}{x}$~~

$\sin 40° = \frac{x}{7.83}$

$7.83\sin(40°) = 5.033$

$\frac{4}{\sin(20)}$ 8) Solve for the ~~hypothesis~~ of the triangle in Figure 4 using inverse of sin. 11.70

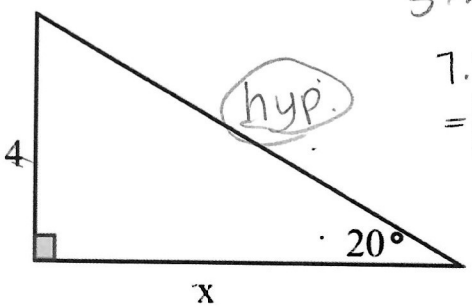


Figure 4

9) Solve for side X using tangent in Figure 4

$\tan(20) = \frac{4}{x}$

$x = \frac{4}{\tan(20)} = 10.99$